



The Consultative Committee for Space Data Systems

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**Draft Recommendation for  
Space Data System Standards**

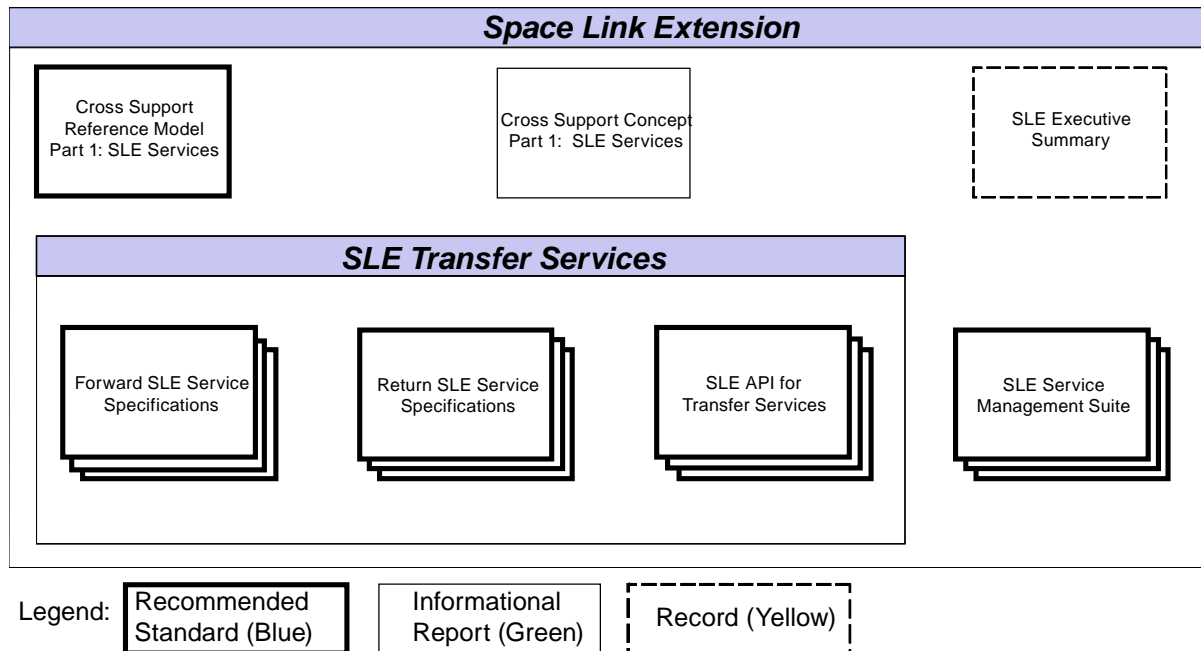
**SPACE LINK EXTENSION—  
FORWARD SPACE  
PACKET SERVICE  
SPECIFICATION**

**DRAFT RECOMMENDED STANDARD**

**CCSDS 912.3-P-1.1**

**PINK SHEETS**

**December 2008**



**Figure 1-1: SLE Services Documentation**

- a) *Cross Support Concept — Part 1: Space Link Extension Services* (reference [G3]): a Report introducing the concepts of cross support and SLE services;
- b) *Cross Support Reference Model — Part 1: Space Link Extension Services* (reference [1]): a Recommended Standard that defines the reference model that provides a common framework and terminology for the specification of SLE services;
- c) *SLE Service Management Specifications*; a set of Recommended Standards that establish the basis of SLE service management;
- d) *Forward SLE Service Specifications*: a set of Recommended Standards that will provide specification of all forward link SLE transfer services (this Recommended Standard is one of the specifications in that set);
- e) *SLE API for Transfer Services Specifications*: a set of Recommended Standards that provide specifications of an Application Program Interface and a mapping to TCP/IP as underlying communications service for SLE services;
- f) *Return SLE Service Specifications*; a set of Recommended Standards that will provide specification of all return link SLE transfer services.

#### **1.6.1.8.5 Initiator**

The initiator is the object that issues the request to bind to another object (the responder).

NOTE – In other words, the initiator is always the invoker of the request to bind to another object. Therefore, in the context of the request to bind, the terms ‘initiator’ and ‘invoker’ refer to the same object and are synonyms.

#### **1.6.1.8.6 Invocation**

The invocation of an operation is the making of a request by an object (the invoker) to another object (the performer) to carry out the operation.

#### **1.6.1.8.7 Parameter**

A parameter of an operation is data that may accompany the operation’s invocation or return.

NOTE – The term parameter is also used to refer to mission-dependent configuration information used in the production or provision of the service.

#### **1.6.1.8.8 Performance**

The performance of an operation is the carrying out of the operation by an object (the performer).

#### **1.6.1.8.9 Port Identifier**

A port identifier identifies a source or a destination in a communications system.

NOTE – See 2.6.4.5 for more information.

#### **1.6.1.8.10 Radiated (Space Packet)**

A Space Packet is said to be radiated when, based on the ground equipment monitoring, the FSP production process can assume that all the CLTUs containing parts of the Space Packet reported have been transmitted to the spacecraft.

#### **1.6.1.8.11 Responder**

The responder is the object that receives a request to bind and completes the binding (if possible) with the initiator in order for a service association to exist between the two objects.

NOTE – In other words, the responder is always the performer of the binding. Therefore, in the context of binding, the terms ‘responder’ and ‘performer’ refer to the same object and are synonyms.

#### **1.6.1.8.12 Return**

The return of an operation is a report, from the performer to the invoker, of the outcome of the performance of the operation.

#### **1.6.1.8.13 Service Instance Provision Period**

A service instance provision period is the time during which a service instance (i.e., the capability to transfer one or more SLE data channels of a given type) is scheduled to be provided.

#### **1.6.1.8.14 Unconfirmed Operation**

An unconfirmed operation is an operation that does not require a report of its outcome to be returned to the invoker by the performer.

### **1.6.2 NOMENCLATURE**

The following nomenclature applies throughout this Recommended Standard:

- a) the words ‘shall’ and ‘must’ imply a binding and verifiable specification;
- b) the word ‘should’ implies an optional, but desirable, specification;
- c) the word ‘may’ implies an optional specification;
- d) the words ‘is’, ‘are’, and ‘will’ imply statements of fact.

### **1.6.3 CONVENTIONS**

#### **1.6.3.1 Specification of Operations**

##### **1.6.3.1.1 General**

Section 3 of this Recommended Standard specifies the operations that constitute the FSP service. The specification of each operation is divided into subsections as follows:

**Table 2-1: FSP Service Operations**

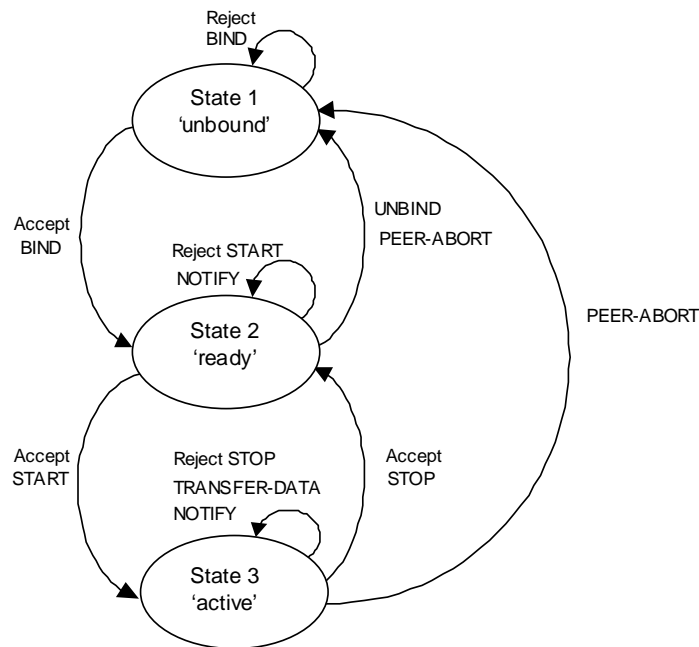
Operations	Invoked By	Purpose	Con- firmed
FSP-BIND	Initiator (User)	To establish an association with the provider	Yes
FSP-UNBIND	Initiator (User)	To release an association previously established by an FSP-BIND operation	Yes
FSP-START	User	To request that the SLE service provider prepare to accept FSP-TRANSFER-DATA operations	Yes
FSP-STOP	User	To request that the provider stop service production for the Space Packets associated with this service instance and not yet <del>processed</del> <u>passed to the segment queues</u> and discard these Space Packets	Yes
FSP-TRANSFER-DATA	User	To transfer a Space Packet to the service provider	Yes
FSP-ASYNC-NOTIFY	Provider	To notify the user of an event affecting production or provision of the FSP service	No
FSP-SCHEDULE-STATUS-REPORT	User	To request that the provider send a status report immediately or periodically, or stop reporting	Yes
FSP-STATUS-REPORT	Provider	To send a status report to the user	No
FSP-GET-PARAMETER	User	To ascertain the value of an SLE service parameter (see tables 3-1 and 3-11)	Yes
FSP-THROW-EVENT	User	To forward an event that requires Complex Management to take the actions defined for this event	Yes
FSP-INVOKE-DIRECTIVE	User	To invoke TC-Directives as specified in reference [5]. TC directives are required to (re-)establish the commanding capability on a given VC	Yes
FSP-PEER-ABORT	User or Provider	To notify the peer that the local SLE application detected an error that requires the association to be terminated	No

### 2.6.4.2 States of the Service Provider

Once an FSP service instance is created, the FSP service provider is in one of three states, as follows:

- a) State 1 ('unbound'): In state 1, all resources required to enable the provision of the FSP service have been allocated, and all objects required to provide the service have been instantiated. However, no association yet exists between the user and the provider (i.e., the FSP transfer service provider port is not bound).
- b) State 2 ('ready'): In state 2, an association has been established between the user and the provider, and they may interact by means of the operations described in section 3 of this Recommended Standard. However, sending of Space Packets from the user to the provider (by means of the FSP-TRANSFER-DATA operation) is not permitted. The user may enable the delivery of Space Packets by means of the appropriate service operation (FSP-START), which, in turn, will cause the provider to transition to state 3 ('active').
- c) State 3 ('active'): State 3 resembles to state 2 ('ready'), except that now the user can send Space Packets. The service continues in this state until the user invokes the FSP-STOP operation to cause the provider to discard any Space Packets belonging to the given service instance and not yet ~~being processed~~ having been passed to the segment queues and to transition back to state 2.

A simplified FSP service provider state transition diagram is shown in figure 2-4. A detailed state transition matrix is provided in 4.2.



**Figure 2-4: Simplified FSP Service Provider State Transition Diagram**

### 2.6.4.3 Terminating an Association

An association is released normally when an FSP-UNBIND is issued by the user (the initiator of the association) and accepted by the provider (the responder). An association may be aborted by either the user or the provider by means of the FSP-PEER-ABORT operation. An association may also be aborted because of a failure in the underlying communications system. Such failures are signaled to the local application entity by the 'protocol abort' event described in 4.1.5.

### 2.6.4.4 Effects of Association Termination

Following the termination of an association, the provider immediately discards all Space Packets buffered for this service instance except any Space Packets that ~~is~~are already in the production process, i.e. that have already been converted to Frame Data Units and passed to the segment queues (see annex B).

When an association is released or aborted, no further operations can be exchanged between the user and the provider. The systems may re-establish an association via a new FSP-BIND operation if that is consistent with the service instance provision period. However, status information from the prior association is not preserved and is not available to the new association except that:

- a) all accounting information, such as number of Space Packets processed, is persistent during the service instance provision period;
- b) parameters that serve to relate notifications on an activity to operations that triggered this activity will not be altered when the association is released or aborted;
- c) COP parameters, i.e. parameters that are set by invoking directives (see 3.12), will not be altered.

### 2.6.4.5 Technology-specific Aspects

This Recommended Standard defines the FSP service. Provision of the FSP service in a real system also requires a specification of how the FSP service defined here is mapped to a communications service such that all invocations and returns of the FSP service operations can be conveyed between the user and the provider. In order not to restrict the applicability of this Recommended Standard to a specific communications technology, as few assumptions as possible have been made about the characteristics of the underlying communications service (see 1.3.1).

The FSP service interface between the user and the provider is specified in this Recommended Standard in terms of the operations that the service provides. Those operations are realized by mapping the service operation invocations and returns to protocol data units that can be conveyed by means of the underlying communications service. This Recommended Standard conceptualizes such mapping in two parts:

between them. The initiator port identifier identifies the endpoint that will invoke the FSP-BIND operation (initiator). The responder port identifier identifies the endpoint that will perform the FSP-BIND operation (responder). Generally speaking, the information represented by a port identifier consists of:

- a) information needed to route data between two real systems over a communications channel or network; and
- b) information needed to route data within a real system to a particular application entity.

For example, the information represented by a port identifier might be the combination of an Internet Protocol (IP) network address and a Transmission Control Protocol (TCP) port number or the combination of an OSI network address and an associated set of service access points (SAPs).

The exact relationship between SLE port identifiers and communications ports provided by the underlying communications service must be specified by the mapping of the FSP service to the underlying communications service.

One possible mapping of the SLE transfer service to the TCP/IP communications service is specified in [G8]. As part of this mapping, also issues such as sizing of TCP buffers in accordance with the bandwidth-delay product of the communication link and ways to manage relative priority of transfer services concurrently using the same connectivity are to be addressed.

In order for an SLE association to be established, SLE Complex Management and SLE Utilization Management must agree beforehand on the responder port identifier for the association. The responder needs the information represented by the responder port identifier to ensure that resources are allocated to recognize and respond to an FSP-BIND invocation for that association. The initiator needs the information to ensure that the FSP-BIND invocation will be communicated to the appropriate responder.

In general, it is not necessary for SLE Complex Management and SLE Utilization Management to agree beforehand on the initiator port identifier for the association. Rather, the initiator should communicate that information to the responder in conjunction with the FSP-BIND invocation. The exact means by which the initiator port identifier is provided to the responder is technology-specific and must be specified by the mapping of the FSP service to the underlying communications service.

The responder port identifier is included as a parameter of the FSP-BIND operation. While it is only necessary that the SLE application entity communicate the information represented by the port identifiers to the underlying communications service, the responder port identifier is provided as a parameter of the FSP-BIND operation to allow for the possible simplification of the implementation of a gateway.

The information represented by the responder port identifier is technology-specific. In order to define the FSP-BIND operation in a way that is not technology-specific, the



### 3.1.5 AUTHENTICATION

NOTE – Requirements for security depend on the application and the ~~SLE-system~~ environment of the SLE Complexes and the MDOS (e.g., whether closed or public networks are used or if access is only from physically restricted areas). In many environments, security may be provided by the communications service, transparently to the SLE application. This Recommended Standard does not preclude the use of security features that are provided by the communications service or the local environment, nor does it assume the availability of such features.

**3.1.5.1** The FSP service shall provide the following options with respect to level of authentication of invocations and returns of operations:

- a) ‘all’: all FSP invocations and returns, except the invocation of FSP-PEER-ABORT, shall be authenticated;
- b) ‘bind’: only the FSP-BIND invocation and return shall be authenticated;
- c) ‘none’: no FSP invocations or returns shall be authenticated.

**3.1.5.2** SLE Complex Management and SLE Utilization Management shall agree on the level of authentication to be required for an association between a service user and a service provider and shall configure both entities accordingly.

**3.1.5.3** SLE Complex Management and SLE Utilization Management shall agree on the algorithm used to generate and check credentials parameters and make this algorithm known to the service user and service provider, together with associated parameters such as passwords or keys as necessary for the selected algorithm.

#### NOTES

- 1 The specification of the algorithms themselves is outside the scope of this Recommended Standard.
- 2 The `initiator-identifier` and `responder-identifier` parameters of the FSP-BIND operation identify the user and provider, respectively, and therefore the applicable authentication level and algorithm necessary to generate and check credentials.

**3.1.5.4** For operations for which authentication is required by the terms of the agreement between SLE Complex Management and SLE Utilization Management:

- a) invocations shall include an `invoker-credentials` parameter to permit the performer to authenticate the invocation; and
- b) returns shall include a `performer-credentials` parameter to permit the invoker to authenticate the return.

**3.1.6.8** Compliance with this Recommended Standard does not require the performer to process invocations concurrently; however, the performer must accept invocations from a non-blocking invoker and buffer and serialize them by local means not visible externally.

### **3.1.7 TIME**

**3.1.7.1** The time reference for all parameters containing a time value shall be based on Coordinated Universal Time (UTC).

**3.1.7.2** The type of parameters containing a time value shall be the CCSDS Day Segmented (CDS) time code format (reference [2]) with ~~a resolution of microseconds~~, an epoch of 1958-01-01 and a 16-bit day segment. Depending on the FSP service provider capabilities and/or the supported mission requirements, the time tag may have either a resolution of microseconds or a resolution of picoseconds.

**3.1.7.3** All time values shall be expressed to a precision of at least one-tenth (0.1) of a second.

**3.1.7.4** All time value shall be accurate to within one-tenth (0.1) of a second or better.

### **3.1.8 DELIVERY MODES**

#### **3.1.8.1 Forward Online Delivery**

**3.1.8.1.1** Forward online delivery service provisioning shall occur at the same time as service production, i.e., during a space link session.

**3.1.8.1.2** Space Packets supplied by the service user are buffered by the service provider until they are processed.

**3.1.8.1.3** The buffer used by the service provider exists only during service provisioning.

**3.1.8.1.4** The timing of Packet processing is determined by the order of Packets in the buffer and any annotation data provided with the Packets (see annex B).

**3.1.8.1.5** Two transmission modes shall be available to the service user:

- a) sequence-controlled (AD);
- b) expedited (BD).

Sequence-controlled transmission mode means that there is a high probability of complete delivery of the Space Packet, that no Packet is duplicated, and that no Packet is delivered out of sequence. Expedited mode delivers Space Packets in the sequence specified but does not guarantee complete delivery.

NOTE – The forward online delivery mode is defined in this Recommended Standard.

Parameter	Service Management	FSP-START Operation	FSP-SCHEDULE-STATUS-REPORT Operation	FSP-INVOKE-DIRECTIVE Operation
vc-multiplexing-control	X			
vc-multiplexing-scheme	X			
<b><u>Parameters applicable to all FSP service instances using a given Physical Channel:</u></b>				
<a href="#">bit-lock-required (see NOTE)</a>	X			
<a href="#">clcw-physical-channel</a>	X			
<a href="#">clcw-global-VCID</a>	X			
<a href="#">rf-available-required (see NOTE)</a>	X			
<b>Parameters applicable to all FSP service instances using a given VC:</b>				
blocking-timeout-period	X			
blocking-usage (blocking performed by the provider)	X			
directive-invocation-enabled	X			
fop-sliding-window	X			X
fop-state	read-only			
map-multiplexing-control	X			X

Parameter	Service Management	FSP-START Operation	FSP-SCHEDULE-STATUS-REPORT Operation	FSP-INVOKE-DIRECTIVE Operation
map-multiplexing-scheme	X			
maximum-frame-length	X			
segment-header	X			
timeout-type	X			X
timer-initial	X			X
transmission-limit	X			X
transmitter-frame-sequence-number	X			X
<b>Parameters applicable to a given service instance:</b>				
apid-list	X			
delivery-mode	X			
expected-packet-identification		X		
map-list	X			
<a href="#">maximum-reporting-cycle</a>	X			
<a href="#">minimum-reporting-cycle</a>	X			
permitted-transmission-mode	X			
reporting-cycle			X	

Parameter	Service Management	FSP-START Operation	FSP-SCHEDULE-STATUS-REPORT Operation	FSP-INVOKE-DIRECTIVE Operation
return-timeout-period	X			
<a href="#">service-instance-provision-period</a>	<a href="#">X</a>			
<a href="#">service-version-number</a>	<a href="#">X</a>			
virtual-channel	X			

NOTE – Strictly speaking, the parameters [bit-lock-required](#) and [rf-available-required](#) are not part of the FSP service, as processing of the associated lock flags in the CLCW is delegated to an underlying F-CLTU Transfer Service or the equivalent (see 2.6.3). Nonetheless these parameters are listed here to underline that the processing of these lock flags is identical for all FSP service instances sharing the same physical channel. Furthermore, the uplink lock status has a significant impact on the FSP service behavior exposed to the user.

### 3.1.10 PROVIDER BUFFERING REQUIREMENTS

**3.1.10.1** The service package shall specify the amount of buffering the provider must maintain.

**3.1.10.2** The amount of buffer space shall be specified in terms of the number of octets that can be stored.

**3.1.10.3** The service provider shall buffer only complete Space Packets.

### 3.1.11 ACCOUNTING SUMMARY

**3.1.11.1** Statistical information to be collected over a period of time shall always refer to the service instance provision period.

**3.1.11.2** Separate information shall be kept for AD and BD modes (see 3.9.2.9 to 3.9.2.11).

**3.2.2.8.2** `version-number` is conditionally present in the return based on the `result` parameter:

- a) if the value of `result` is 'positive result', `version-number` shall be present in the return;
- b) if the value of `result` is 'negative result', `version-number` shall not be present in the return.

**3.2.2.8.3** If the value of `result` is 'positive result', the responder shall either:

- a) accept the version proposed by the initiator by putting the same version number into the positive return; or
- b) if the responder supports version negotiation, propose a lower (earlier) version number by putting the lower version number into the return.

**3.2.2.8.4** If the responder implementation does not support the requested version and does not support a lower version (or does not support version negotiation), the responder shall reject the bind with the `diagnostic` parameter set to 'version not supported'.

**3.2.2.8.5** If the responder proposes a lower version in the return and the initiator does not support version negotiation or does not support the version proposed by the responder, the initiator shall unbind the association.

**3.2.2.8.6** The `version-number` value of the FSP service defined by this issue of this Recommended Standard shall be '12'.

NOTE – The version negotiation process as outlined above is only feasible as long as future versions of the FSP service retain the specification of the FSP-BIND operation.

### **3.2.2.9 service-instance-identifier**

The **`service-instance-identifier`** parameter shall uniquely identify this service instance within the scope of the service-providing SLE Complex.

### **3.2.2.10 result**

The **`result`** parameter shall specify the result of the FSP-BIND invocation and shall contain one of the following values:

- a) 'positive result'—the FSP-BIND operation has been performed by the responder and the association is established;

### 3.4 FSP-START

#### 3.4.1 PURPOSE

**3.4.1.1** The user shall invoke the FSP-START operation to request that the provider prepare to receive FSP-TRANSFER-DATA invocations (see 3.6).

**3.4.1.2** The provider shall return a report of the outcome of the performance of the FSP-START operation to the user.

**3.4.1.3** The FSP-START operation shall allow the FSP service provider to return to the user the times scheduled for start and stop of service production.

**3.4.1.4** The FSP-START operation is valid only in state 2 ('ready') and shall be invoked only by the user.

NOTE – The COP-1 protocol will be set up in accordance with the parameter values supplied by service management. The user may modify these parameter values by invoking any necessary FSP-INVOKE-DIRECTIVE operations, provided the FSP-INVOKE-DIRECTIVE operation is enabled for the given service instance (see 3.12).

#### 3.4.2 INVOCATION, RETURN, AND PARAMETERS

##### 3.4.2.1 General

The parameters of the FSP-START operation shall be present in the invocation and return as specified in table 3-4.

**Table 3-4: FSP-START Parameters**

Parameter	Invocation	Return
invoker-credentials	M	
performer-credentials		M
invoke-ID	M	M
first-packet-identification	M	
start-production-time	<del>M</del>	<u>C</u>
stop-production-time	<del>M</del>	<u>C</u>
result		M
diagnostic		C

#### 3.5.2.4 **invoke-ID**

The FSP service provider shall return unchanged the user-supplied value of the **invoke-ID** parameter (see 3.1.6).

#### 3.5.2.5 **result**

The **result** parameter shall specify the result of the FSP-STOP operation and shall contain one of the following values:

- a) 'positive result'—the FSP-STOP operation has been performed by the provider, and the user may invoke an FSP-UNBIND operation or a new FSP-START operation;
- b) 'negative result'—the FSP-STOP operation has not been performed by the provider for the reason specified by the **diagnostic** parameter.

#### 3.5.2.6 **diagnostic**

**3.5.2.6.1** If **result** is 'negative result', the **diagnostic** parameter shall be present in the return, and its value shall contain one of the following:

- a) 'duplicate invoke-ID'—the value of the **invoke-ID** parameter is the same as the **invoke-ID** value of a previous, outstanding operation;
- b) 'other reason'—the reason for the negative result will have to be found by other means.

**3.5.2.6.2** If **result** is 'positive result', the **diagnostic** parameter shall not be present in the return.

### 3.5.3 **EFFECTS**

**3.5.3.1** If **result** is 'positive result', the FSP-STOP operation shall have the following effects:

- a) the provider shall transition to state 2 ('ready') and shall no longer accept FSP-TRANSFER-DATA invocations;
- b) for Space Packets queued for this service instance:
  - ~~1) the provider shall discard any Packets for which processing has not yet begun;~~
  - ~~2) the provider shall not discard, but shall complete processing, Packets for which processing has already begun;~~



- 1) the provider shall discard any Packets that have not yet been passed to the segment queue;
- 2) the provider shall not discard, but shall complete processing, of Packets that have been converted to Frame Data Units and passed to the segment queues;
- c) if a radiation or transfer report has been requested by the user for a Space Packet that is already being processed, the report shall be generated and sent to the user by means of an FSP-ASYNC-NOTIFY operation.

**3.5.3.2** If `result` is 'negative result':

- a) processing shall continue;
- b) the provider state shall remain unchanged;
- c) any buffered Space Packets shall not be discarded.

**3.6.2.9.3** If an FSP-TRANSFER-DATA invocation with the parameter `transmission-mode` set to ‘sequence-controlled and unblock AD mode’ is accepted, the AD mode is unblocked.

NOTE – AD Packets will be accepted again as soon as the AD mode is unblocked regardless of the current transmission mode capability. If the submitted packet requires AD mode and the production time is specified such that production of that packet has to be started before the sequence-controlled transmission mode was re-established, a further ‘transmission mode mismatch’ event will occur and AD mode will be blocked again.

### **3.6.2.10 MAP-identifier**

**3.6.2.10.1** The **MAP-identifier** parameter shall specify the Multiplexer Access Point (MAP) to be used for the transmission of the Space Packet contained in the `data` parameter.

NOTE – If the MAP multiplexing scheme (see table 3-11) is set to ‘polling vector’ and the MAP-identifier associated with the Space Packet transferred by the user is not an element of the polling vector, but an element of the list of MAP-ID permitted for the given Service Instance (see parameter `map-list` in table 3-11), the packet will be queued, but not processed as long as the multiplexing scheme is not modified such that the given MAP-identifier would be processed.

**3.6.2.10.2** If the service instance is configured to not generate Segment Headers, this parameter must be set to ‘none’.

### **3.6.2.11 blocking**

**3.6.2.11.1** The **blocking** parameter shall specify whether the Space Packet may be blocked with other Space Packets into one TC frame.

**3.6.2.11.2** If **blocking** is set to ‘yes’, depending on the availability of other Space Packets on the same MAP and the space left in the frame being built, the Packet may be merged with other Packets into one TC frame.

**3.6.2.11.3** If **blocking** is set to ‘no’, the Space Packet shall be inserted into a frame carrying that Packet only.

NOTE – Service management may elect to set the **blocking-usage** parameter to ‘not permitted’ (see table 3-11). In that case, the provider will ignore the **blocking** parameter and each frame will encapsulate at most one Space Packet.

#### 3.6.2.12 processing-started-notification

The **processing-started-notification** parameter shall specify whether the provider shall invoke the FSP-ASYNC-NOTIFY operation upon forwarding of the Packet from the packets queue to the segments queue (see annex B for the definition of these queues), and shall contain one of the following values:

- a) 'produce notification'—invoke an FSP-ASYNC-NOTIFY operation upon forwarding of the Packet to the segments queue;
- b) 'do not produce notification'—do not invoke the FSP-ASYNC-NOTIFY operation.

#### 3.6.2.13 radiated-notification

The **radiated-notification** parameter shall specify whether the provider shall invoke the FSP-ASYNC-NOTIFY operation upon completion of the radiation of the Space Packet, and shall contain one of the following values:

- a) 'produce notification'—invoke an FSP-ASYNC-NOTIFY operation upon completion of the radiation;
- b) 'do not produce notification'—do not invoke the FSP-ASYNC-NOTIFY operation.

#### 3.6.2.14 acknowledged-notification

The **acknowledged-notification** parameter shall specify whether the provider shall invoke an FSP-ASYNC-NOTIFY operation upon completion of the transfer of the Space Packet, i.e., when all Segments of the Packet have been acknowledged by the spacecraft in the CLCW, and shall contain one of the following values:

- a) 'produce notification'—invoke an FSP-ASYNC-NOTIFY operation upon completion of the transfer; this value is allowed only when transmission-mode is 'sequence-controlled';
- b) 'do not produce notification'—do not invoke the FSP-ASYNC-NOTIFY operation.

#### 3.6.2.15 data

The **data** parameter shall contain a Space Packet for transfer to the space element of a mission.

#### 3.6.2.16 packet-buffer-available

The **packet-buffer-available** parameter shall specify the remaining number of octets available to this service instance for buffering of Space Packets [in the request queue](#).

### 3.6.2.17 result

The **result** parameter shall specify the result of the FSP-TRANSFER-DATA operation and shall contain one of the following values:

- a) 'positive result'—the FSP-TRANSFER-DATA operation has been performed by the provider, and the Space Packet will be queued until processing is due;
- b) 'negative result'—the FSP-TRANSFER-DATA operation has not been performed by the provider, for the reason specified by the **diagnostic** parameter, and the Space Packet has not been queued.

### 3.6.2.18 diagnostic

**3.6.2.18.1** If **result** is 'negative result', the **diagnostic** parameter shall be present in the return and its value shall be one of the following:

- a) 'duplicate invoke-ID'—the value of the **invoke-ID** parameter is the same as the **invoke-ID** value of a previous, outstanding operation;
- b) 'unable to process'—the provider cannot process Space Packets for one of the following reasons:
  - 1) the provider cannot process Space Packets because the **production-status** parameter is not 'operational'; this has been reported to the user via an FSP-ASYNC-NOTIFY operation containing the **notification-type** value 'production interrupted' or 'production halted';
  - 2) the **production-status** is 'operational' but the provider is blocked due to an earlier fault: the provider has reported the fault condition to the user by a CLTU-ASYNC-NOTIFY operation containing the **notification-type** value 'production interrupted' and has reported the recovery from the fault condition to the user by a CLTU-ASYNC-NOTIFY operation containing the **notification-type** value 'production operational';
  - 3) the provider cannot process Space Packets because the service instance is blocked following a condition which has been reported to the user via an FSP-ASYNC-NOTIFY operation containing the **notification-type** value 'sldu expired';
  - 4) the **production-status** is 'operational', but the provider has temporarily suspended production to process a FSP-THROW-EVENT invocation: no fault condition has been reported to the user;
- c) 'unable to store'—there is not enough buffer space available in the request queue of this service instance to store this Space Packet;
- d) 'out of sequence'—the value of the **packet-identification** parameter is not equal to the value expected by the provider, which is one of the following:

### 3.7 FSP-ASYNC-NOTIFY

#### 3.7.1 PURPOSE

**3.7.1.1** The FSP service provider shall invoke the FSP-ASYNC-NOTIFY operation to notify the user of an event affecting the production of the FSP service.

NOTE – Notification of events may be of value to the user in understanding specific provider behavior, such as an interruption of the command radiation.

**3.7.1.2** The FSP-ASYNC-NOTIFY operation shall be an unconfirmed operation.

NOTE – Notifications from the provider are delivered to the user asynchronously to the flow of FSP-TRANSFER-DATA operations from the user to the provider.

**3.7.1.3** The FSP-ASYNC-NOTIFY operation is valid only in states 2 ('ready') and 3 ('active') and shall be invoked only by the provider.

#### 3.7.2 INVOCATION, ~~RETURN~~, AND PARAMETERS

##### 3.7.2.1 General

The parameters of the FSP-ASYNC-NOTIFY operation shall be present in the invocation as specified in table 3-7.

**Table 3-7: FSP-ASYNC-NOTIFY Parameters**

Parameters	Invocation
invoker-credentials	M
notification-type	M
directive-executed-identification	C
event-thrown-identification	C
packet-identification-list	C
fop-alert	C
packet-identification-last-processed	M
production-start-time	C
packet-status	C
packet-identification-last-ok	M
production-stop-time	C
production-status	M

The value of this entry will always be the same as the value of the `packet-identification-last-ok` parameter.

- 2 The Space Packet is guaranteed to have been received by the space element, but not necessarily accepted. Packet assembly or execution may not have been carried out correctly. This can only be determined by examining telemetry.
- d) ‘sldu expired’—processing of the Packet identified by the value of the first entry in the `packet-identification-list` parameter did not begin by the time specified in the `latest-production-time` parameter of this Space Packet. This event shall only be notified to the user who submitted the affected Space Packet.

## NOTES

- 1 After the ‘sldu expired’ event, Space Packets belonging to this service instance and not yet ~~being processed~~having been passed to the segment queues in the form of Frame Data Units will be discarded. The identifications of these discarded Packets are entered in the `packet-identification-list` parameter. The user should resend all Packets referenced in the `packet-identification-list` parameter to the provider.
- 2 Further FSP-TRANSFER-DATA invocations will be blocked, i.e., rejected with an ‘unable to process’ diagnostic. The user has to clear the blocking by invoking an FSP-STOP operation. In order to resume the transfer and processing of Space Packets, after confirmation of the FSP-STOP, the user must invoke FSP-START.
- e) ‘packet transmission mode mismatch’—the current provider configuration prevents the transmission of Space Packets in the requested mode, but `production-status` is still ‘operational’. The requested mode may be disabled by service management, or the provider configuration in effect, resulting from FSP-INVOKE-DIRECTIVE invocations or FOP alerts, does not permit the transmission of Space Packets in the requested mode. All Space Packets with a currently not supported transmission mode for which production did not yet complete and belong to the given user shall be identified in the `packet-identification-list` parameter and shall be discarded by the provider. This means that also Frame Data Units derived from Space Packets requiring the no longer supported transmission mode have to be discarded (see B3.14). This event shall only be notified to users with Space Packets that were discarded because of the not available sequence-controlled transmission mode.

## NOTES

- 1 If the current `packet-identification-last-processed` value is also an entry in `packet-identification-list`, and the `packet-status` value of that packet was ‘packet processing started’, then the `packet-status` value will be updated to ‘unsupported transmission mode’ and the

production-stop-time parameter value will indicate the time when the transmission mode capability changed. If the packet-status value of that packet was 'radiated', then the packet-status value is left unchanged.

- 2 All users of the affected VC connected at the time when a change of the transmission mode capability occurs will receive a 'transmission mode capability change' notification. Users with Space Packets, for which processing is starting or has started but did not complete yet and require a currently not supported transmission mode, will receive in addition the 'packet transmission mode mismatch' notification.
  - 3 After the 'packet transmission mode mismatch' event, service production and processing of Space Packets continues, but all Space Packets requiring the no longer supported transmission mode and belonging to a service instance with at least one Space Packet requiring the sequence-controlled transmission mode and being processed are discarded. The AD mode for this service instance is blocked and FSP-TRANSFER-DATA invocations requesting the sequence-controlled transmission mode will be rejected until an FSP-TRANSFER-DATA invocation requesting the unblocking of the sequence-controlled mode has been received (see 3.6.2.9). The user should retransmit to the provider all Packets identified in the packet-identification-list parameter when the desired transmission mode is available again.
- f) 'transmission mode capability change'—a change in the capability to handle AD packets occurred. This event shall be notified to a given user:
- 1) only if the production-status is still 'operational'; or
  - 2) if production-status changed from 'operational' with a sub-state different from 'BD' to 'interrupted', but the given user is not notified of this production status transition because this user has no Packets for which processing has started but did not yet complete; i.e., no Packets of this user are currently in the packets queues and no Frame Data Units generated from Packets of this user are in the segment queues.

NOTE – This event occurs as a result of FOP alerts, the successful completion of certain directives and when the allowed number of transmissions specified in the transmission-limit parameter (see table 3-1) has been completed. The parameter production-status indicates the current capability. A FOP alert may cause a 'packet transmission mode mismatch' event that will then be notified separately (see 3.7.2.3e)). B3.14 specifies which packets are discarded in such case.

- g) 'buffer empty'—the provider has no further Space Packets buffered for this service instance. This event shall:
- 1) only be notified to the user of the given service instance;

- 2) not be notified if it is the result of an FSP-STOP operation or an ‘sldu expired’, ‘packet transmission mode mismatch’, ‘production interrupted’, ‘VC aborted’, or ‘production halted’ event.
- h) ‘no invoke directive capability on this VC’—the service instance for which the FSP-INVOKE-DIRECTIVE is enabled is no longer connected to the service provider because of an FSP-UNBIND, FSP-PEER-ABORT, or ‘protocol abort’ event for that instance. This event shall be notified to all users currently connected to the service provider and using the affected VC.

NOTE – This notification is not applicable to the service instance that has been enabled to invoke the FSP-INVOKE-DIRECTIVE operation.

- i) ‘invoke directive capability on this VC established’—the service instance for which the FSP-INVOKE-DIRECTIVE is enabled just bound to the service provider by means of a successful FSP-BIND operation. This event shall be notified to all users currently connected to the service provider and using the affected VC.

NOTE – This notification is not applicable to the service instance that has been enabled to invoke the FSP-INVOKE-DIRECTIVE operation.

- j) ‘positive confirm response to directive’—the directive identified in the directive-executed-identification parameter completed successfully. This notification indicates that COP-1 (including FARM-1 for directives requiring receiving-end action) was able to complete the execution of the directive. This event shall only be notified to the user who invoked the FSP-INVOKE-DIRECTIVE operation.
- k) ‘negative confirm response to directive’—the directive identified in the directive-executed-identification parameter did not complete successfully.

NOTE – The ‘negative confirm response to directive’ notification does not carry a parameter giving the reason for the failure to confirm performance of the actions invoked by the directive. However, a ‘transmission mode capability change’ notification together with the fop-alert parameter may arise independently and may explain why the directive was not implemented.

- l) ‘VC aborted’—this event occurs as a result of successful execution of the ‘abort VC’ directive (see 3.12.2.6). This event shall be notified to all currently connected users of the affected VC.

## NOTES

- 1 All Space Packets belonging to this VC are discarded. [This also applies to packets already converted to Frame Data Units and passed to the segment queues.](#) For each user, all discarded Space Packets, for which production did not yet complete, are identified in the packet-identification-list parameter.



The user should retransmit to the provider all Packets listed in the `packet-identification-list` parameter.

- 2 The `packet-identification-list` will not contain any entry if no Packets of the given user were buffered and/or being processed when the ‘abort VC’ directive was invoked.
- m) ‘production interrupted’—processing aborted for the Packets belonging to this service instance and the Packets identified in the `packet-identification-list` parameter were discarded. [This also applies to packets already converted to Frame Data Units and passed to the segment queues.](#) This event occurs when `production-status` is ‘interrupted’ and at least one Packet belonging to this service instance has the `packet-status` ‘production started’ or, in case of an AD Packet, ‘radiated’ or the processing of a Packet has to be started based on the specified `earliest-production-time` and `latest-production-time` parameters. The production process is stopped; however, it may still be functional. This event shall be notified to all users affected by the interruption of the production process, i.e. to all users with Packets for which processing has started but did not yet complete.

## NOTES

- 1 If at the time where the `production-status` changes to ‘interrupted’ no Space Packets of a given user are being processed, no ‘production interrupted’ notification is sent to this user and no Packets belonging to this user are discarded. If the `production-status` is still ‘interrupted’ when, according to the `earliest-production-time` and/or `latest-production-time` parameters, the next Space Packet of this user starts to be processed, the notification will be sent at that time to this user.
- 2 The production process is currently interrupted due to a (possibly transient) problem affecting the production process. The processing of Space Packets of the notified user is stopped and all Space Packets identified in the `packet-identification-list` parameter have been discarded. [This also applies to packets already converted to Frame Data Units and passed to the segment queues.](#) Further FSP-TRANSFER-DATA invocations will be blocked, i.e., rejected with ‘unable to process’ diagnostic. The user has to clear the blocking by invoking an FSP-STOP operation and wait for a positive FSP-STOP return. When the production problem is cleared, the user will be notified of the ‘production operational’ event. In order to resume the transfer and processing of Space Packets, the user must invoke FSP-START. The user should retransmit to the provider all Space Packets listed in the `packet-identification-list` parameter.
- n) ‘production halted’—the production process has been stopped and `production-status` changed to ‘halted’; this event shall be notified to all users connected to the

service provider at the point in time when the production-status change occurred.

## NOTES

- 1 The production process enters the halted status by service management decision, for example in case of malfunctioning equipment.
  - 2 The production process is stopped and all buffered Space Packets are discarded. [This also applies to packets already converted to Frame Data Units and passed to the segment queues.](#) For each user, all discarded Space Packets are identified in the packet-identification-list parameter. Further FSP-TRANSFER-DATA invocations will be blocked, i.e., rejected with ‘unable to process’ diagnostic. The user has to clear the blocking by invoking an FSP-STOP operation and wait for a positive FSP-STOP return. When service management decides that production will be resumed, the user is notified of this production-status transition by the ‘production operational’ event. In order to resume the transfer and processing of Space Packets, the user must invoke FSP-START. The user should retransmit to the provider all Packets listed in the packet-identification-list parameter.
  - 3 The packet-identification-list will not contain any entry if no Packets of the given user were buffered and/or being processed when production-status changed to ‘halted’.
- o) ‘production operational’—the production process is ready to process Space Packets and production-status has changed to ‘operational’. This event shall be notified to all users who did not yet receive any notification regarding the current production-status or had been notified of any production-status different from ‘operational’.

## NOTES

- 1 This event occurs when the forward space link has been successfully established or following actions to restore production to operational status after a halt or interrupt.
  - 2 It is permissible to send this notification also to users if the most recent notification received by them was ‘production operational’.
  - 3 After this transition, the initial sub-state of the production-status is ‘BD’;
- p) ‘action list completed’—all actions associated with the event triggered by an FSP-THROW-EVENT operation identified by the event-thrown-identification parameter have successfully completed. This event shall only be notified to the user who invoked the FSP-THROW-EVENT operation.

NOTE – The production-status ‘operational’ occurs: when the production equipment is configured for support and has completed the acquisition sequence; when a problem that caused the production-status ‘interrupted’ is cleared; when service management restarts the production process after the production-status was ‘halted’.

- c) ‘interrupted’—the production process has detected a problem that prevents it from processing Space Packets; the problem may be transient and may be cleared for instance by automatic equipment reconfiguration;

NOTE – When production-status changes from ‘operational’ to ‘interrupted’, the transmission mode capability may change as well, but the notification with notification-type ‘transmission mode capability change’ is suppressed (see 3.7.2.3), if the sub-state of the production-status was ‘BD’ before the transition to ‘interrupted’ occurred or if the given user is immediately notified of the transition of the production-status to ‘interrupted’ because Packets of this user are discarded since processing of them had been started, but did not yet complete.

- d) ‘halted’—service management has taken the production process out of service for instance because the problem that caused the production-status to change to ‘interrupted’ is more severe and not of transient nature or because the resources have to be re-assigned.

## NOTES

- 1 Reassignment of resources may become necessary e.g. because of a spacecraft emergency.
- 2 When production-status changes from ‘operational’ to ‘halted’, the transmission mode capability may change as well, but the notification with notification-type ‘transmission mode capability change’ will be suppressed (see 3.7.2.3), since the change of the production-status to ‘halted’ is notified to all users anyway.

## 3.7.3 EFFECTS

### 3.7.3.1 If notification-type indicates ‘sldu expired’:

- a) all Space Packets queued for this service instance and not yet ~~being processed~~passed to the segment queues in the form of Frame Data Units shall be discarded; and
- b) further FSP-TRANSFER-DATA invocations shall be rejected.

### 3.7.3.2 If notification-type indicates ‘production interrupted’, or ‘production halted’:

- a) all Space Packets belonging to this service instance shall be discarded ~~regardless if processing of the Packet has started or not~~ including those converted already to Frame Data Units and passed to the segment queues; and
- b) further FSP-TRANSFER-DATA invocations shall be rejected.

**3.7.3.3** If notification-type indicates 'packet transmission mode mismatch': all Space Packets currently being processed or buffered and requiring the not supported transmission mode shall be discarded including those converted to Frame Data Units and passed to the segment queues.

**3.7.3.4** If notification-type indicates 'VC aborted': all Space Packets ~~regardless if processing of the Packet has started or not~~ shall be discarded including those converted already to Frame Data Units and passed to the segment queues.

**3.7.3.5** There shall be no effect for any other values of notification-type.

**3.7.3.6** The provider shall remain in its original state, i.e., state 2 ('ready') or state 3 ('active').

- a) Space Packets that were acknowledged;
- b) Space Packets that radiated successfully, but were not (yet) acknowledged;
- c) Space Packets that aborted;
- d) Space Packets currently being processed.

**3.9.2.10.2** This parameter shall include separate values for AD packets and BD packets.

**3.9.2.10.3** If no Space Packets have been processed, this parameter shall be set to zero ('0').

### **3.9.2.11 number-of-packets-radiated**

**3.9.2.11.1** The **number-of-packets-radiated** parameter shall specify the number of Space Packets successfully radiated during this service instance.

**3.9.2.11.2** A Space Packet in the process of being radiated shall not be included in this count.

**3.9.2.11.3** For a given Space Packet, only its first radiation shall be counted; retransmission of frames in accordance with COP-1, which may imply retransmission of complete Packets, shall not cause this parameter to be updated.

**3.9.2.11.4** This parameter shall include separate values for AD packets and BD packets.

**3.9.2.11.5** If no Space Packets have been radiated, this parameter shall be set to zero ('0').

### **3.9.2.12 number-of-packets-acknowledged**

**3.9.2.12.1** The **number-of-packets-acknowledged** parameter only applies to sequence-controlled transmission mode and shall specify the number of Space Packets that during this service instance were successfully transferred to the space element as determined by evaluation of CLCWs.

**3.9.2.12.2** If Space Packets have been acknowledged, this parameter shall be set to zero ('0').

### **3.9.2.13 packet-buffer-available**

**3.9.2.13.1** The **packet-buffer-available** parameter shall specify the number of octets ~~in the buffer~~ available ~~to~~in the request queue of this service instance for Packet storage.

NOTE – This parameter shall reflect the ~~sum of~~ free storage space in the request queue ~~and the MAP queues~~ belonging to the given service instance (see annex B).

### 3.10.2.3 performer-credentials

The **performer-credentials** parameter shall provide information that enables the invoker to authenticate the return from the performance of FSP-GET-PARAMETER (see 3.1.5).

### 3.10.2.4 invoke-ID

The performer shall return unchanged the invoker-supplied value of the **invoke-ID** parameter (see 3.1.6).

### 3.10.2.5 fsp-parameter

**3.10.2.5.1** The **fsp-parameter** parameter shall specify the FSP service parameter whose value is to be returned to the user, and its value shall be one of the values listed in table 3-11.

**Table 3-11: FSP Service Parameters**

Parameter	Description
apid-list	List of APIDs the given service instance is authorized to access.
<a href="#">bit-lock-required</a>	<a href="#">If the value is 'yes', the 'No bit lock' flag in the CLCW must be false in order for the provider to set production-status to 'operational'.</a>
blocking-timeout-period	Period from inserting the first Packet into the Frame Data Unit until this unit is passed to the FOP regardless of the number of Packets contained; this timeout period is applicable to all blocking regardless of the specific MAP.
blocking-usage	'permitted' if the provider may block multiple Space Packets into a single frame, 'not permitted' otherwise; the permission to block Space Packets applies to all MAPs in use on the given VC.
delivery-mode	'fwd online'
directive-invocation-online	'yes', if the service instance that is permitted to invoke directives for the given VC if any is in the state 'ready' or 'active', 'no', if that service instance is in the state 'unbound'.
directive-invocation-enabled	'enabled' if this service instance is authorized to invoke the FSP-INVOKE-DIRECTIVE operation, 'disabled' otherwise.
expected-directive-identification	The <code>directive-identification</code> parameter value the provider expects in the next FSP-INVOKE-DIRECTIVE invocation.

Parameter	Description
expected-event-invocation-identification	The event-invocation-identification parameter value the provider expects in the next FSP-THROW-EVENT invocation. The initial value of this parameter is zero.
expected-sldu-identification	The packet-identification parameter value the provider expects in the next FSP-TRANSFER-DATA invocation; If no FSP-START operation has been performed, zero shall be returned as the default value of this parameter.
fop-sliding-window	Number of frames that can be transmitted on the given VC before an acknowledgement is required.
fop-state	State of the FOP on the given VC: 'ACTIVE', 'RETRANSMIT WITHOUT WAIT', 'RETRANSMIT WITH WAIT', 'INITIALIZING WITHOUT BC FRAME', 'INITIALIZING WITH BC FRAME', 'INITIAL'.
map-list	List of MAPs permitted to be used by the given service instance if MAPs are used, 'null' otherwise.
map-multiplexing-control	MAP priority list or MAP polling vector; if the map-multiplexing-scheme is 'FIFO' or if MAPs are not used, this parameter is 'null'. This parameter applies to the given VC.
map-multiplexing-scheme	MAP multiplexing scheme in effect on the given VC: 'FIFO', 'absolute priority', 'polling vector'. If no MAP multiplexing is used, this parameter must be set to 'FIFO'.
maximum-frame-length	Mission maximum TC transfer frame length in octets ( <a href="#">see NOTE</a> ).
maximum-packet-length	Mission maximum Packet Data Length in octets ( <a href="#">see NOTE</a> ).
permitted-transmission-mode	Specifies the transmission mode permitted for the given service instance; it may be 'expedited' or 'sequence-controlled' or 'any'.
reporting-cycle	<a href="#">The current setting of the reporting cycle for status reports (see 3.8 and 3.9): the value is 'null' if cyclic reporting is off, otherwise it is the time (in seconds) between <del>subsequent</del> successive FSP-STATUS-REPORT invocations (see <del>3.8.2.6</del> 3.8).</a>
return-timeout-period	<del>Maximum period permitted from invocation of a confirmed FSP operation until the return must be received by the invoker.</del> <a href="#">The maximum time period (in seconds) permitted from when a confirmed Forward CLTU operation is invoked until the return is received by the invoker (see 4.1.3).</a>

Parameter	Description
<a href="#">rf-available-required</a>	<a href="#">If the value is 'yes', the 'No RF available' flag in the CLCW must be false in order for the provider to set production-status to 'operational'.</a>
segment-header	Specifies if a Segment Header is 'present' or 'absent' in the TC transfer frames. <a href="#">(see NOTE).</a>
timeout-type	Specifies FOP behavior (either 'Alert' or 'AD service suspension').
timer-initial	Initial value for countdown timer when an AD or BC frame is transmitted.
transmission-limit	Maximum number of times the first frame on the Sent_Queue may be transmitted (see [5]).
transmitter-frame-sequence-number	After a transmission mode capability change event, the parameter Transmitter_Frame_Sequence_Number, V(S), contains the value of the Frame Sequence Number, N(S), to be put in the Transfer Frame Primary Header of the next Type-AD frame to be transmitted.
vc-multiplexing-control	VC priority list or the VC polling vector; if the vc-multiplexing scheme is 'FIFO', this parameter is 'null'.
vc-multiplexing-scheme	VC multiplexing scheme in effect: 'FIFO', 'absolute priority', 'polling vector'.
virtual-channel	VC being used by this service instance.

[NOTE – Service Management has to ensure that the chosen values of the parameters \[maximum-frame-length\]\(#\), \[maximum-packet-length\]\(#\) and \[segment-header\]\(#\) are consistent. An example of an inconsistent parameter setting would be a \[maximum-frame-length\]\(#\) of 100 octets, a \[maximum-packet-length\]\(#\) of 1024 octets and \[segment-header\]\(#\) 'absent'. In such case a packet of say 250 octets could not be processed as it does not fit into the frame, but due to the absence of the segment header the packet cannot be segmented either. Any inconsistent combination of parameter values shall be rejected at configuration time. FSP is not designed to deal with such inconsistencies at run time.](#)

**3.10.2.5.2** fsp-parameter is conditionally present in the return based on the result parameter:

- if the value of result is 'positive result', fsp-parameter shall be present in the return;
- if the value of result is 'negative result', fsp-parameter shall not be present in the return.



- d) 'protocol error'—the local application entity detected an error in the sequencing of FSP service operations;
- e) 'communications failure'—the communications service on the other side of a gateway was disrupted.

NOTE – This diagnostic value is only applicable when the SLE application entities are communicating via a gateway.

- f) 'encoding error'—the local application detected an error in the encoding of one or more operation parameters or did not recognize the operation;
- g) 'return timeout'—the local application entity detected that the return from a confirmed operation was not received within the time specified by the return-timeout-period parameter (see 4.1.3).
- h) 'end of service instance provision period'—the local application entity detected that the service instance provision period has ended and the initiator has not invoked the FSP-UNBIND operation;
- i) 'unsolicited invoke-ID'—the local application entity received a return with an `invoke-ID` that does not match the `invoke-ID` of any of the operations for which the return is pending;
- j) 'other reason'—the local application entity detected an unspecified error during the processing of one or more operations.

NOTE – FSP-PEER-ABORT does not carry an `invoker-credentials` parameter. It is conceivable that an intruder might use the FSP-PEER-ABORT operation for a denial-of-service attack. If an intruder has the required capability of breaking into an existing connection, then a denial-of-service attack can be much more easily accomplished by disrupting communications at a lower than the application layer. Therefore, authentication of the FSP-PEER-ABORT operation would not provide improved protection against such attacks.

### 3.13.3 EFFECTS

The FSP-PEER-ABORT operation shall have the following effects:

- a) the association shall be aborted and the provider shall transition to state 1 ('unbound');
- ~~b) all Space Packets buffered for this service instance by the provider and not yet being in the state 'processing' shall be discarded;~~
- b) all Space Packets buffered for this service instance by the provider that have not yet been converted to Frame Data Units and passed to the segment queues shall be discarded;

## 4 FSP PROTOCOL

### 4.1 GENERIC PROTOCOL CHARACTERISTICS

NOTE – This section specifies the handling of invalid SLE-PDUs and other failures affecting the protocol.

#### 4.1.1 UNEXPECTED SLE PROTOCOL DATA UNIT

If the peer application entity sends an invocation or return not allowed in the current state of the performer, the performer shall abort the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'protocol error'.

#### 4.1.2 INVALID SLE PROTOCOL DATA UNIT

If the application entity receives an invocation or return that contains an unrecognized operation type, contains a parameter of a wrong type, or is otherwise not decodable, the application entity shall abort the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'encoding error'.

#### 4.1.3 MISSING RETURN

For confirmed operations, if the invoker does not receive the return from the performer within the return-timeout-period specified by service management, the invoker shall abort the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'return timeout'.

#### NOTES

- 1 The return-timeout-period shall be chosen taking into account performance of user and provider applications as well as the delays introduced by the underlying communications service.
- 2 In order to provide responsive service and short return-timeout-periods, the generation of the return from an operation must not depend on any human interaction.
- 3 After invoking the FSP-UNBIND operation, the initiator must not invoke any further operations [with the exception of the case addressed in 3.3.1.4](#) nor send any returns. The responder is not required to send any pending returns after having received the FSP-UNBIND invocation. Therefore, following an FSP-UNBIND invocation, the 'missing return' event may occur.

#### 4.1.4 UNSOLICITED RETURN

If the application entity receives a return with an `invoke-ID` parameter value that does not correspond to any invocation for which the return is still pending, the application entity shall abort the association by invoking the FSP-PEER-ABORT operation with the `diagnostic` parameter set to 'unsolicited invoke-ID'.

#### 4.1.5 COMMUNICATIONS FAILURE

**4.1.5.1** Every SLE entity (i.e., every SLE user or provider) that is in an association (bound) with a peer SLE entity shall maintain knowledge of the health of the communications interface with the peer.

**4.1.5.2** If an SLE entity is informed by its underlying communications service that communications with the peer entity have been disrupted (e.g., due to a communications failure), then this entity shall consider that the association with the peer entity has been aborted. Occurrence of such communications failure event shall be referred to as a 'protocol abort'.

NOTE – The exact criteria for determining when communications have been disrupted may depend on the characteristics of the communications technology used and may be specific to a given implementation. However, it is a firm requirement on any communications service underlying an SLE transfer service that it includes suitable means to ascertain the status of the connection (see 1.3.1). In the case of communications protocols that do not intrinsically provide such a capability, the transmission of a periodic 'heartbeat' indicator or equivalent may need to be implemented.

**4.1.5.3** Subsequent to a 'protocol abort' event:

- a) the FSP provider shall transition to state 1 ('unbound');
- b) neither the user nor the provider shall attempt further communications with the peer except that the user may attempt to re-establish the association by invoking the FSP-BIND operation;
- c) the provider shall discard all Space Packets buffered for this service instance except those already converted to Frame Data Units and passed to the segment queues;
- d) the values of FSP service provision parameters shall return to the initial values set by service management for that service instance;
- e) statistical information required for the generation of status reports shall be retained throughout the service instance provision period; and
- f) parameters that serve to relate notifications on an activity to operations that triggered that activity (such as `directive-executed-identification`) shall not be altered.

Table 4-1: Provider Behavior

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
1	(fspBindInvocation)	IF "positive result" .AND. "production configured" THEN {accept bind} → 2 ELSE IF "positive result" THEN (+fspBindReturn) → 2 ELSE (-fspBindReturn)	<del>IF "same service instance"</del> <del>THEN (-fspBindReturn ('already bound'))</del> <del>ELSE {peer abort ('protocol error')} → 1</del>	<del>IF "same service instance"</del> <del>THEN (-fspBindReturn ('already</del> <del>bound'))</del> <del>ELSE {peer abort ('protocol error')} → 1</del>
2	'end of service instance provision period'	[ignore]	{peer abort ('end of service instance provision period')} → 1	{peer abort ('end of service instance provision period')} → 1
3	(fspUnbindInvocation)	[ignore]	(fspUnbindReturn) → 1 stop reporting-cycle timer stop all return-timeout-period timers set "notify production operational" to FALSE IF "end" THEN release resources ELSE [ignore]	{peer abort ('protocol error')} → 1
4	(fspStartInvocation)	[ignore]	IF "positive result" THEN (+fspStartReturn) → 3 ELSE IF "production off" THEN {reject start} ELSE (-fspStartReturn)	{peer abort ('protocol error')} → 1
5	(fspStopInvocation)	[ignore]	{peer abort ('protocol error')} → 1	IF "positive result" THEN {initiate stop} → 2 ELSE (-fspStopReturn)
6	(fspTransferDataInvocation) with BD Packet	[ignore]	{peer abort ('protocol error')} → 1	IF "positive result" .AND. (.NOT. "service instance blocked") THEN queue packet (+fspTransferDataReturn) ELSE discard packet (-fspTransferDataReturn)

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
7	(fspTransferDataInvocation) with AD Packet and unblock AD	[ignore]	{peer abort <protocol error>} → 1	IF "positive result" .AND. (.NOT. "service instance blocked") .AND. ("AD blocked") THEN queue packet Set "AD blocked" to FALSE (+fspTransferDataReturn) ELSE discard packet (-fspTransferDataReturn)
8	(fspTransferDataInvocation) with AD Packet and .NOT. unblock AD	[ignore]	{peer abort <protocol error>} → 1	IF "positive result" .AND. (.NOT. "service instance blocked") .AND. (.NOT. "AD blocked") THEN queue packet (+fspTransferDataReturn) ELSE discard packet (-fspTransferDataReturn)
9	(fspScheduleStatusReportInvocation)	[ignore]	IF "positive result" THEN (+fspScheduleStatusReportReturn) IF "immediately" THEN {immediate report} ELSE IF "periodically" THEN {periodic report} ELSE stop reporting-cycle timer ELSE (-fspScheduleStatusReportReturn)	IF "positive result" THEN (+fspScheduleStatusReportReturn) IF "immediately" THEN {immediate report} ELSE IF "periodically" THEN {periodic report} ELSE stop reporting-cycle timer ELSE (-fspScheduleStatusReportReturn)
10	'reporting-cycle timer expired'	Not applicable	{periodic report}	{periodic report}
11	'return-timeout-period timer <n> expired'	Not applicable	{peer abort <return timeout>} → 1	{peer abort <return timeout>} → 1
12	(fspGetParameterInvocation)	[ignore]	IF "positive result" THEN (+fspGetParameterReturn) ELSE (-fspGetParameterReturn)	IF "positive result" THEN (+fspGetParameterReturn) ELSE (-fspGetParameterReturn)

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
13	(fspThrowEventInvocation)	[ignore]	IF "positive result" THEN (+fspThrowEventReturn) forward event to Complex Management ELSE (-fspThrowEventReturn)	IF "positive result" THEN (+fspThrowEventReturn) forward event to Complex Management ELSE (-fspThrowEventReturn)
14	(fspInvokeDirectiveInvocation)	[ignore]	{peer abort { <del>'protocol error'</del> } → 1	IF "positive result" THEN queue directive (+fspInvokeDirectiveReturn) ELSE (-fspInvokeDirectiveReturn)
15	'packet processing started'	Not applicable	Not applicable	IF "report processing" THEN {notify ' <a href="#">packet processing started</a> '} ELSE [ignore]
16	'packet acknowledged'	Not applicable	IF "report acknowledgement" THEN {notify ' <a href="#">packet acknowledged</a> '} ELSE [ignore]	IF "report acknowledgement" THEN {notify ' <a href="#">packet acknowledged</a> '} ELSE [ignore]
17	'packet radiated'	Not applicable	IF "report radiation" THEN {notify ' <a href="#">packet radiated</a> '} ELSE [ignore]	IF "report radiation" THEN {notify ' <a href="#">packet radiated</a> '} ELSE [ignore]
18	'sldu expired'	Not applicable	Not applicable	{notify ' <a href="#">sldu expired</a> ' and block}
19	'packet transmission mode mismatch'	Not applicable	Not applicable	{notify and block AD}
20	'transmission mode capability change'	Not applicable	{notify ' <a href="#">transmission mode capability change</a> '}	{notify ' <a href="#">transmission mode capability change</a> '}
21	'VC aborted'	Not applicable	{notify ' <a href="#">VC aborted</a> '}	{notify ' <a href="#">VC aborted</a> '}
22	'production interrupted'	Not applicable	Not applicable	{notify ' <a href="#">production interrupted</a> ' and block} set "notify production operational" to TRUE
23	'production halted'	Not applicable	{notify ' <a href="#">production halted</a> '} set "notify production operational" to TRUE	{notify ' <a href="#">production halted</a> ' and block} set "notify production operational" to TRUE

No.	Incoming Event	Unbound (State 1)	Ready (State 2)	Active (State 3)
24	'production operational'	Not applicable	IF "notify production operational" THEN {notify <a href="#">'production operational'</a> } set "notify production operational" to FALSE	IF "notify production operational" THEN {notify <a href="#">'production operational'</a> } set "notify production operational" to FALSE
25	'buffer empty'	Not applicable	{notify <a href="#">'buffer empty'</a> }	{notify <a href="#">'buffer empty'</a> }
26	'no invoke directive capability on this VC'	Not applicable	{notify <a href="#">'no invoke directive capability on this VC'</a> }	{notify <a href="#">'no invoke directive capability on this VC'</a> }
27	'invoke directive capability on this VC'	Not applicable	{notify <a href="#">'invoke directive capability on this VC established'</a> }	{notify <a href="#">'invoke directive capability on this VC established'</a> }
28	'positive confirm response to directive'	Not applicable	{notify <a href="#">'positive confirm response to directive'</a> }	{notify <a href="#">'positive confirm response to directive'</a> }
29	'negative confirm response to directive'	Not applicable	{notify <a href="#">'negative confirm response to directive'</a> }	{notify <a href="#">'negative confirm response to directive'</a> }
30	'action list completed'	Not applicable	{notify <a href="#">'action list completed'</a> }	{notify <a href="#">'action list completed'</a> }
31	'action list not completed'	Not applicable	{notify <a href="#">'action list not completed'</a> }	{notify <a href="#">'action list not completed'</a> }
32	'event condition evaluated to false'	Not applicable	{notify <a href="#">'event condition evaluated to false'</a> }	{notify <a href="#">'event condition evaluated to false'</a> }
33	(fspPeerAbortInvocation)	[ignore]	{clean up} → 1	{clean up} → 1
34	'protocol abort'	[ignore]	{clean up} → 1	{clean up} → 1
35	'unsolicited invoke-ID'	[ignore]	{peer abort <a href="#">'unsolicited invoke-ID'</a> } → 1	{peer abort <a href="#">'unsolicited invoke-ID'</a> } → 1
36	'invalid SLE-PDU'	[ignore]	{peer abort <a href="#">'encoding error'</a> } → 1	{peer abort <a href="#">'encoding error'</a> } → 1
37	'unexpected SLE-PDU'	[ignore]	{peer abort <a href="#">'protocol error'</a> } → 1	{peer abort <a href="#">'protocol error'</a> } → 1
38	'not authenticated SLE-PDU'	[ignore]	[ignore]	[ignore]

**Table 4-2: Event Description References**

<b>Event</b>	<b>Reference</b>
'action list completed'	3.7.2.3
'action list not completed'	3.7.2.3
'buffer empty'	3.7.2.3
'end of service instance provision period'	3.13.2.2
'event condition evaluated to false'	3.7.2.3
'invalid SLE-PDU'	4.1.2
'invoke directive capability on this VC <a href="#">established</a> '	3.7.2.3
'negative confirm response to directive'	3.7.2.3
'no invoke directive capability on this VC'	3.7.2.3
'not authenticated SLE-PDU'	4.1.7
'packet acknowledged'	3.7.2.3
'packet processing started'	3.7.2.3
'packet radiated'	3.7.2.3
'packet transmission mode mismatch'	3.7.2.3
'positive confirm response to directive'	3.7.2.3
'production halted'	3.7.2.3
'production interrupted'	3.7.2.3
'production operational'	3.7.2.3
'protocol abort'	4.1.5
'reporting-cycle timer expired'	3.8.3
'return-timeout-period timer <n> expired'	4.1.3
'sldu expired'	3.7.2.3
'transmission mode capability change'	3.7.2.3
'unexpected SLE-PDU'	4.1.1
'unsolicited invoke-ID'	3.13.2.2
'VC aborted'	3.7.2.3



**Table 4-3: Predicate Definitions**

<b>Predicate</b>	<b>Evaluates to TRUE if</b>
"end"	all checks on the (fspUnbindInvocation) PDU are passed and the <code>unbind-reason</code> parameter value is 'end'
"immediately"	all parameter checks on the (fspScheduleStatusReportInvocation) PDU are passed and the <code>report-request-type</code> parameter value is 'immediately'
"periodically"	all parameter checks on the (fspScheduleStatusReportInvocation) PDU are passed and the <code>report-request-type</code> parameter value is 'periodically'
"positive result"	all checks on the given invocation PDU are passed
"production configured"	The current value of <code>production-status</code> is 'configured'
"production off"	The <code>diagnostic</code> parameter value in the (–fspStartReturn) is either 'out of service' or 'unable to comply'
"report processing"	the <code>processing-started-notification</code> parameter value was 'produce notification' in the (fspTransferDataInvocation) PDU for the Space Packet associated with the processing event
"report radiation"	the <code>radiated-notification</code> parameter value was 'produce notification' in the (fspTransferDataInvocation) PDU for the Space Packet associated with the radiation event
"report acknowledgement"	the <code>acknowledged-notification</code> parameter value was 'produce notification' in the (fspTransferDataInvocation) PDU for the Space Packet associated with the transfer event
" <del>same service instance</del> "	<del>the service instance identifier value in the FSP-BIND invocation denotes a service instance that is already bound via an association different from the one used to convey this FSP-BIND invocation</del>

**Table 4-4: Boolean Flags**

<b>Flag Name</b>	<b>Initial Value</b>
"AD blocked"	FALSE
"notify production operational"	FALSE
"service instance blocked"	FALSE

**Table 4-5: Compound Action Definitions**

Name	Actions Performed
{accept bind}	(+fspBindReturn) set “notify production operational” to TRUE
{clean up}	stop reporting-cycle timer stop all return-timeout-period timers set “notify production operational” to FALSE clear Packets relating to the service instance from the packet queues reset service provision parameters
{immediate report}	(fspStatusReportInvocation) stop reporting-cycle timer
{initiate stop}	clear Packets relating to the service instance from the packet queues set “service instance blocked” to FALSE set “AD blocked” to FALSE (+fspStopReturn)
{notify ‘xxx’}	(fspAsyncNotifyInvocation) with notification-type set to ‘xxx’, i.e., to the value corresponding to the incoming event
{notify ‘xxx’ and block}	(fspAsyncNotifyInvocation) with invoke-ID value <n> and notification-type set to ‘xxx’, i.e., to the value corresponding to the incoming event clear Packets relating to the service instance from the requests and packets queues set “service instance blocked” to TRUE
{notify ‘xxx’ and block AD}	(fspAsyncNotifyInvocation) with invoke-ID value <n> and notification-type set to ‘xxx’, i.e., to the value corresponding to the incoming event clear AD Packets relating to the service instance from the requests and packets queues set “AD blocked” to TRUE
{peer abort (‘xxx’)}	(fspPeerAbortInvocation) with diagnostic set to ‘xxx’ stop reporting-cycle timer stop all return timers set “notify production operational” to FALSE clear Packets relating to the service instance from the packet queues

```

ParameterName ::= INTEGER
{
    apidList (2)
    , bitLockRequired (3)
    , blockingTimeoutPeriod (0)
    , blockingUsage (1)
    , bufferSize (4)
    , deliveryMode (6)
    , directiveInvocation (7)
    , directiveInvocationOnline (108)
    , expectedDirectiveIdentification (8)
    , expectedEventInvocationIdentification (9)
    , expectedSlduIdentification (10)
    , fopSlidingWindow (11)
    , fopState (12)
    , latencyLimit (15)
    , mapList (16)
    , mapMuxControl (17)
    , mapMuxScheme (18)
    , maximumFrameLength (19)
    , maximumPacketLength (20)
    , maximumSlduLength (21)
    , modulationFrequency (22)
    , modulationIndex (23)
    , permittedControlWordTypeSet (101)
    , permittedGvcidSet (24)
    , permittedTcVcidSet (102)
    , permittedTransmissionMode (107)
    , permittedUpdateModeSet (103)
    , plopInEffect (25)
    , reportingCycle (26)
    , requestedControlWordType (104)
    , requestedFrameQuality (27)
    , requestedGvcid (28)
    , requestedTcVcid (105)
    , requestedUpdateMode (106)
    , returnTimeoutPeriod (29)
    , rfAvailable (30)
    , rfAvailableRequired (31)
    , segmentHeader (32)
    , subcarrierToBitRateRatio (34)
    , timeoutType (35)
    , timerInitial (36)
    , transmissionLimit (37)
    , transmitterFrameSequenceNumber (38)
    , vcMuxControl (39)
    , vcMuxScheme (40)
    , virtualChannel (41)
}

SlduStatusNotification ::= INTEGER
{
    produceNotification (0)
    , doNotProduceNotification (1)
}

SpaceLinkDataUnit ::= OCTET STRING (SIZE (41 .. 65536))

```

```

Time                ::= CHOICE
{
  ccsdsFormat        [0]    TimeCCSDS
, picoFormat         [1]    TimeCCSDSpico
}

TimeCCSDS            ::= OCTET STRING (SIZE(8))
-- P-field is implicit (not present, defaulted to 41 hex
-- T-field:
-- 2 octets: number of days since 1958/01/01 00:00:00
-- 4 octets: number of milliseconds of the day
-- 2 octets: number of microseconds of the millisecond
--      (set to 0 if not used)
-- This definition reflects exactly the format of the CCSDS defined
-- time tag as used in spacelink data units (see Time Code Formats.
-- Recommendation for Space Data Systems Standards, CCSDS 301.0-B-3.
-- Blue Book. Issue 3. Washington, D.C.: CCSDS, January 2002).

TimeCCSDSpico       ::= OCTET STRING (SIZE(10))
-- P-field is implicit (not present, defaulted to 42 hex
-- T-field:
-- 2 octets: number of days since 1958/01/01 00:00:00
-- 4 octets: number of milliseconds of the day
-- 4 octets: number of picoseconds of the millisecond
--       (set to 0 if not used)
-- This definition reflects exactly the format of the CCSDS defined
-- time tag as used in spacelink data units (see Time Code Formats.
-- Recommendation for Space Data System Standards, CCSDS 301.0-B-3.
-- Blue Book. Issue 3. Washington, D.C.: CCSDS, January 2002).

END

```

```

FspGetParameter ::= CHOICE
{
  parApidList [0] SEQUENCE
  {
    parameterName ParameterName (apidList)
    ,
    parameterValue ApidList
  }
  ,
  parBitLockRequired [27] SEQUENCE
  {
    parameterName ParameterName (bitLockRequired)
    ,
    parameterValue INTEGER
    {
      yes (0)
      ,
      no (1)
    }
  }
  ,
  parBlockingTimeout [1] SEQUENCE
  {
    parameterName ParameterName(blockingTimeoutPeriod)
    ,
    parameterValue CHOICE
    {
      blockingOff [0] NULL
      ,
      blockingOn [1] BlockingTimeoutPeriod
    }
  }
  ,
  parBlockingUsage [2] SEQUENCE
  {
    parameterName ParameterName (blockingUsage)
    ,
    parameterValue BlockingUsage
  }
  ,
  parDeliveryMode [3] SEQUENCE
  {
    parameterName ParameterName (deliveryMode)
    ,
    parameterValue FspDeliveryMode
  }
  ,
  parDirectiveInvoc [4] SEQUENCE
  {
    parameterName ParameterName (directiveInvocation)
    ,
    parameterValue INTEGER
    {
      enabled (0)
      ,
      disabled (1)
    }
  }
  ,
  parDirInvocOnl [5] SEQUENCE
  {
    parameterName ParameterName (directiveInvocationOnline)
    ,
    parameterValue INTEGER
    {
      yes (0)
      ,
      no (1)
    }
  }
  ,
  parExpectDirectiveId [6] SEQUENCE
  {
    parameterName ParameterName (expectedDirectiveIdentification)
    ,
    parameterValue IntUnsignedLong
  }
  ,
  parExpectEventInvId [7] SEQUENCE
  {
    parameterName ParameterName
    (expectedEventInvocationIdentification)
    ,
    parameterValue IntUnsignedLong
  }
  ,
  parExpectSliduId [8] SEQUENCE
  {
    parameterName ParameterName (expectedSliduIdentification)
    ,
    parameterValue PacketIdentification
  }
  ,
  parFopSlidWindow [9] SEQUENCE
  {
    parameterName ParameterName (fopSlidingWindow)
    ,
    parameterValue INTEGER (1 .. 255)
  }
  ,
  parFopState [10] SEQUENCE
  {
    parameterName ParameterName (fopState)
    ,
    fopState INTEGER
  }
}

```

```

        { active (0)
        , retransmitWithoutWait (1)
        , retransmitWithWait (2)
        , initialisingWithoutBCFrame (3)
        , initialisingWithBCFrame (4)
        , initial (5)
        }
    }
, parMapList [11] SEQUENCE
  { parameterName ParameterName (mapList)
  , mapList MapList
  }
, parMapMuxControl [12] SEQUENCE
  { parameterName ParameterName (mapMuxControl)
  , parameterValue MuxControl
  }
, parMapMuxScheme [13] SEQUENCE
  { parameterName ParameterName (mapMuxScheme)
  , parameterValue MapMuxScheme
  }
, parMaxFrameLength [14] SEQUENCE
  { parameterName ParameterName (maximumFrameLength)
  , parameterValue INTEGER (12 .. 1024) -- octets
  }
, parMaxPacketLength [15] SEQUENCE
  { parameterName ParameterName (maximumPacketLength)
  , parameterValue INTEGER (7 .. 65542)
  }
, parPermTransMode [16] SEQUENCE
  { parameterName ParameterName (permittedTransmissionMode)
  , parameterValue PermittedTransmissionMode
  }
, parReportingCycle [17] SEQUENCE
  { parameterName ParameterName (reportingCycle)
  , parameterValue CurrentReportingCycle
  }
, parReturnTimeout [18] SEQUENCE
  { parameterName ParameterName (returnTimeoutPeriod)
  , parameterValue TimeoutPeriod
  }
, parRfAvailableRequired [28] SEQUENCE
  { parameterName ParameterName (rfAvailableRequired)
  , parameterValue INTEGER
  { yes (0)
  , no (1)
  }
  }
]
, parSegmHeader [19] SEQUENCE
  { parameterName ParameterName (segmentHeader)
  , parameterValue INTEGER
  { present (0)
  , absent (1)
  }
  }
, parTimeoutType [20] SEQUENCE
  { parameterName ParameterName (timeoutType)
  , parameterValue INTEGER
  { generateAlert (0)
  , suspendSequenceControlled (1)
  }
  }

```

```

FspPacketLastOk ::= CHOICE
{
  noPacketOk [0] NULL
,
  packetOk [1] SEQUENCE
  {
    packetIdentification PacketIdentification
  ,
    processingStopTime Time
  }
}

FspPacketLastProcessed ::= CHOICE
{
  noPacketProcessed [0] NULL
,
  packetProcessed [1] SEQUENCE
  {
    packetIdentification PacketIdentification
  ,
    processingStartTime Time
  ,
    packetStatus FspPacketStatus
  }
}

FspPacketStatus ::= ForwardDuStatus
(
  acknowledged
|
  radiated
|
  productionStarted
|
  productionNotStarted
|
  expired
|
  unsupportedTransmissionMode
|
  interrupted
)

FspParameterName ::= ParameterName
(
  apidList
|
  bitLockRequired
|
  blockingTimeoutPeriod
|
  blockingUsage
|
  deliveryMode
|
  directiveInvocation
|
  directiveInvocationOnline
|
  expectedDirectiveIdentification
|
  expectedSlduIdentification
|
  expectedEventInvocationIdentification
|
  fopSlidingWindow
|
  fopState
|
  mapList
|
  mapMuxControl
|
  mapMuxScheme
|
  maximumFrameLength
|
  maximumPacketLength
|
  permittedTransmissionMode
|
  reportingCycle
|
  returnTimeoutPeriod
|
  rfAvailableRequired
|
  segmentHeader
|
  timeoutType
|
  timerInitial
|
  transmissionLimit
|
  transmitterFrameSequenceNumber
|
  vcMuxControl
|
  vcMuxScheme
|
  virtualChannel
)

```

```

FspProductionStatus ::= INTEGER
{
    configured          (0)
    , operationalBd      (1)
    , operationalAdAndBd (2)
    , operationalAdSuspended (3)
    , interrupted        (4)
    , halted             (5)
}

Map ::= CHOICE
{
    none          [0] NULL
    , mapUsed     [1] MapId
}

MapId ::= VcOrMapId

-- The entries shall be in ascending order.
MapList ::= CHOICE
{
    mapsNotUsed [0] NULL
    , mapsUsed  [1] SEQUENCE SIZE (1 .. 64) OF MapId
}

MapMuxControl ::= CHOICE
{
    absolutePriority [0] SEQUENCE SIZE (1 .. 64) OF AbsolutePriority
    , pollingVector [1] SEQUENCE SIZE (1 .. 192) OF MapId
}

MapMuxScheme ::= CHOICE
{
    noMapsUsed [0] NULL
    , mapsUsed [1] MuxScheme
}

MuxControl ::= CHOICE
{
    muxSchemeIsFifo [0] NULL
    , muxSchemeIsPriority [1] SEQUENCE SIZE (1 .. 64) OF AbsolutePriority
    , muxSchemeIsVector [2] SEQUENCE SIZE (1 .. 192) OF VcOrMapId
}

MuxScheme ::= INTEGER
{
    fifo (0)
    , absolute-priority (1)
    , polling-vector (2)
}

NegativeConfirmResponseToDirective ::= SEQUENCE
{
    directiveExecutedId DirectiveExecutedId
    , fopAlert          FopAlert
}

PacketIdentification ::= IntUnsignedLong

PacketIdentificationList ::= SEQUENCE OF PacketIdentification

PermittedTransmissionMode ::= INTEGER
{
    sequenceControlled (0)
    , expedited (1)
    , any (2)
}

```



- b) If the multiplexing scheme is ‘absolute priority’, the segments queue of the MAP with the highest priority shall be checked first for an available Frame Data Unit. If none is available, the queue with the second highest priority is checked and so forth until a Frame Data Unit is found. The Frame Data Unit found is extracted from its segments queue and passed to the FOP. The search for available Frame Data Units is resumed starting again from the queue with the highest priority. The same applies when all queues have been checked and no Frame Data Unit was found.
- c) If the multiplexing scheme is ‘polling vector’, the segments queues shall be checked in accordance with the entries of the polling vector, taking the entries of the vector in sequence. When a Frame Data Unit is found, it is extracted from the segments queues and passed to the FOP. The checking of the segment queues continues from the next entry of the vector. When the last entry of the vector is reached, the process continues from the vector’s first entry.

**B3.11** If Segment Headers and/or MAPs are not used on a VC, the MAP multiplexing process shall select the segments queue containing the Frame Data Unit with the earliest time stamp.

**B3.12** Directives are inserted in a directives queue for immediate execution.

**B3.13** In response to an FSP-STOP or FSP-PEER-ABORT invocation and subsequent to a ‘sldu expired’ (see 3.7.2.3) or ‘protocol abort’ event (see 4.1.5), any Packet belonging to the affected service instance and not yet in the ~~state ‘processing’, i.e., not yet in the~~ segments queue, shall be discarded; Frame Data Units in the segments queues shall be retained.

**B3.14** The event ‘packet transmission mode mismatch’ shall cause discarding of:

- a) all Frame Data Units currently in the segments queues that encapsulate Packets requiring the no longer supported sequence-controlled (AD) transmission mode;
- b) all Space Packets in the packets and requests queues with the transmission-mode parameter set to ‘sequence-controlled’ and belonging to a service instance of which at least one Packet in the segments queues was discarded; Packets with transmission-mode set to ‘expedited’ shall be retained and processed normally.

**B3.15** When the directive ‘abort VC’ is carried out, all queues of the VC on which the directive was invoked shall be cleared, i.e., all Packets in the requests queues and the already built Frame Data Units in the segments queues shall be discarded.

**B3.16** When production-status changes to ‘interrupted’, all segment queues, all packets queues and all requests queues belonging to service instances, for which Frame Data Units were in the segments queues when the event occurred, shall be cleared.

**B3.17** When production-status changes to ‘halted’, all queues shall be cleared, i.e., all Packets in the requests and packet queues and the already built Frame Data Units in the segments queues shall be discarded.

**Table D-1: Production Status Transitions**

Start Status	End Status	Cause of Status Change	Notification
'configured'	'operational'	Management action to make the production-status 'operational'; this typically includes ensuring the availability of the underlying FTCF and Forward CLTU services.	'production operational' See NOTE 1 <a href="#">and 3</a>
'operational'	'interrupted'	Occurrence of a production fault detected by the FSP provider.	'production interrupted' See NOTE <a href="#">24</a> <a href="#">and 5</a>
'interrupted'	'operational'	Maintenance action typically is required to correct the production fault (e.g. re-configuration to use an alternate FTCF provider). The FSP production-status changes to 'operational' when the provider detects that the fault is corrected.	'production operational' See NOTE 1 <a href="#">and 3</a>
[any]	'halted'	Direct management action is required such as an operator directive causing the provider to halt production	'production halted'
'halted'	'configured'	Direct management action is required such as an operator directive restoring the required configuration and declaring the production-status to be 'configured'.	none

**NOTES**

- 1 The notification 'production operational' is sent only to those service instances that were not yet notified since the most recent FSP-BIND operation of the 'operational' status and/or were notified of a production-status different from 'operational'.
- 2 [The initial production-status value is 'configured'. When requested by the supported agency \(either by schedule or via voice communication\), the supporting agency starts CMM-1 by turning on the uplink and performing the nominal uplink sweep in accordance with the mission specific parameters. It should be noted that the PLOP implementation as described below is not part of the FSP service proper, but is implemented by an underlying F-CLTU service or equivalent. However, as this underlying service may not be exposed to the user except via the FSP service, the impact on the observable FSP service behavior is defined below.](#)
- 3 [production-status changes from 'configured' to 'operational':](#)

- a) at completion of the uplink sweep, if plop-in-effect is 'PLOP-1' and rf-available-required is set to 'no';
  - b) at completion of the uplink sweep, if plop-in-effect is 'PLOP-1', rf-available-required is set to 'yes' and the CLCW indicates 'RF available';
  - c) at completion of the radiation of the acquisition sequence, if plop-in-effect is 'PLOP-2', rf-available-required is set to 'no' and bit-lock-required is set to 'no';
  - d) at completion of the radiation of the acquisition sequence, if plop-in-effect is 'PLOP-2', rf-available-required is set to 'yes', the CLCW indicates 'RF available' and bit-lock-required is set to 'no';
  - e) at completion of the radiation of the acquisition sequence, if plop-in-effect is 'PLOP-2', rf-available-required is set to 'no', bit-lock-required is set to 'yes' and the CLCW flags 'bit lock';
  - f) at completion of the radiation of the acquisition sequence, if plop-in-effect is 'PLOP-2', rf-available-required is set to 'yes', if bit-lock-required is set to 'yes' and the CLCW indicates both 'RF available' and 'bit lock'.
- 4 The notification 'production interrupted' is only sent to those service instances that are affected by the possibly transient production fault, i.e. service instances of which Space Packets are being processed when the production-status changes to 'interrupted' and for which a Space Packet becomes due to be processed while the production-status is 'interrupted'.
- 5 The production-status changes to 'interrupted' when the checking of uplink-status is required (rf-available-required and/or bit-lock required set to 'yes') and uplink-status has no longer the required value.

The effects of the production-status parameter value on the processing of confirmed FSP operations are specified in 3.2 to 3.12. For convenience, this information is summarized in table D-2.

Term	Reference
SLE service package	reference [1]
<del>SLE System</del>	<del>reference [1]</del>
SLE transfer service instance	reference [1]
SLE transfer service production	reference [1]
SLE transfer service provision	reference [1]
SLE Utilization Management	reference [1]
space link	reference [1]
space link data channel	reference [1]
Space Link Data Unit (SL-DU)	reference [1]
space link session	reference [1]
Space Packet	reference [6]
T1_Initial	reference [5]
telecommand Packet (TC packet)	reference [6]
Segment	reference [4]
telecommand transfer frame (TC frame)	reference [4]
Timeout_Type	reference [5]
Transmitter_Frame_Sequence_Number V(S)	reference [5]
unconfirmed operation	subsection 1.6.1.8.14
Virtual Channel (VC)	reference [4]

**ANNEX G****INFORMATIVE REFERENCES****(INFORMATIVE)**

- [G1] *Procedures Manual for the Consultative Committee for Space Data Systems*. CCSDS A00.0-Y-9. Yellow Book. Issue 9. Washington, D.C.: CCSDS, November 2003.
- [G2] *Telecommand Summary of Concept and Rationale*. Report Concerning Space Data System Standards, CCSDS 200.0-G-6. Green Book. Issue 6. Washington, D.C.: CCSDS, January 1987.
- [G3] *Cross Support Concept — Part 1: Space Link Extension Services*. Report Concerning Space Data System Standards, CCSDS 910.3-G-3. Green Book. Issue 3. Washington, D.C.: CCSDS, March 2006.
- [G4] *Telecommand Part 1—Channel Service*. Recommendation for Space Data System Standards, CCSDS 201.0-B-3-S. Historical Recommendation. Issue 3-S. Washington, D.C.: CCSDS, (June 2000) August 2005.
- [G5] *Telecommand Part 2—Data Routing Service*. Recommendation for Space Data System Standards, CCSDS 202.0-B-3-S. Historical Recommendation. Issue 3-S. Washington, D.C.: CCSDS, (June 2001) August 2005.
- [G6] *Telecommand Part 2.1—Command Operation Procedures*. Recommendation for Space Data System Standards, CCSDS 202.1-B-2-S. Historical Recommendation. Issue 2-S. Washington, D.C.: CCSDS, (June 2001) August 2005.
- [G7] *Telecommand Part 3—Data Management Service*. Recommendation for Space Data System Standards, CCSDS 203.0-B-2-S. Historical Recommendation. Issue 2-S. Washington, D.C.: CCSDS, (June 2001) August 2005.
- [G8] [\*Space Link Extension—Internet Protocol for Transfer Services\*. Recommendation for Space Data System Standards, CCSDS 913.1-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2008.](#)